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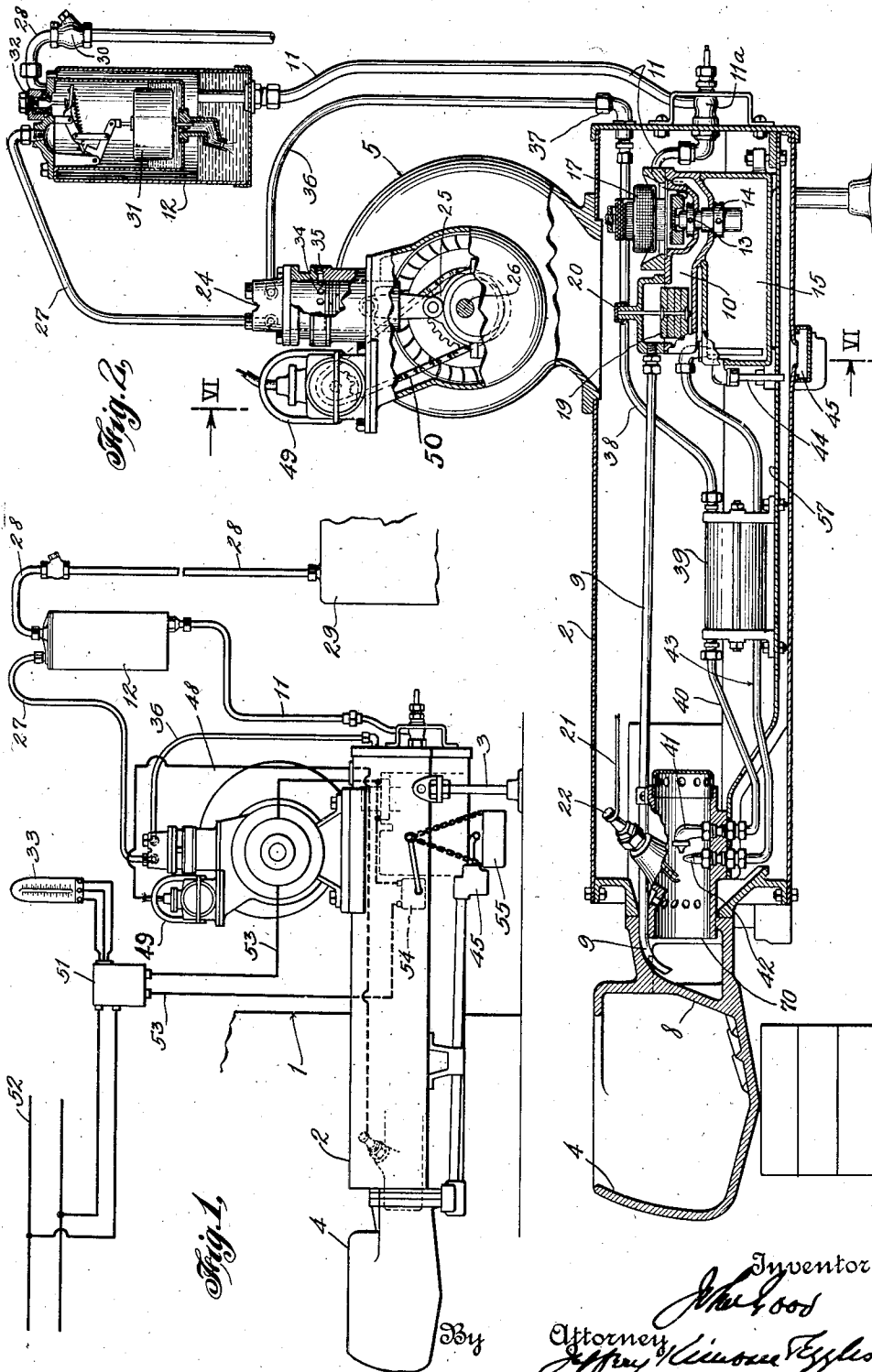
J. GOOD

1,723,031

OIL BURNING APPARATUS

Filed Aug. 6, 1924

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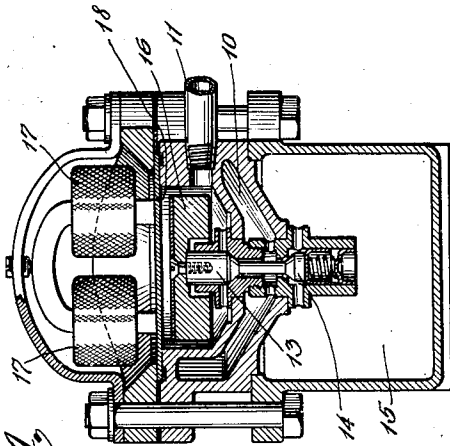


Fig. 4

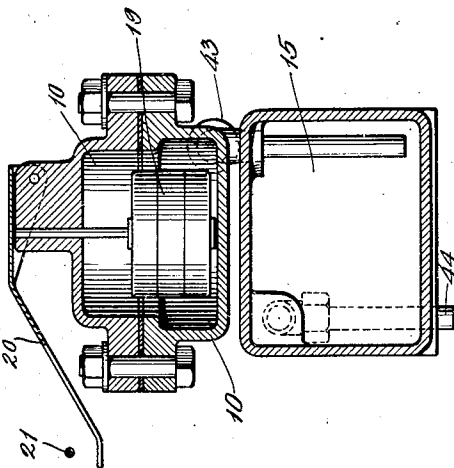


Fig. 5

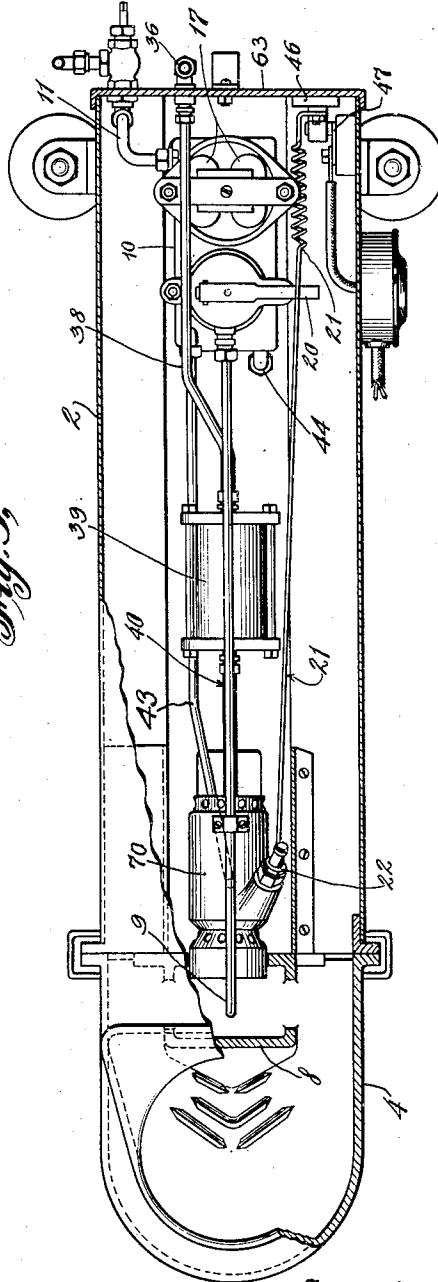


Fig. 3

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4 Sheets-Sheet 3

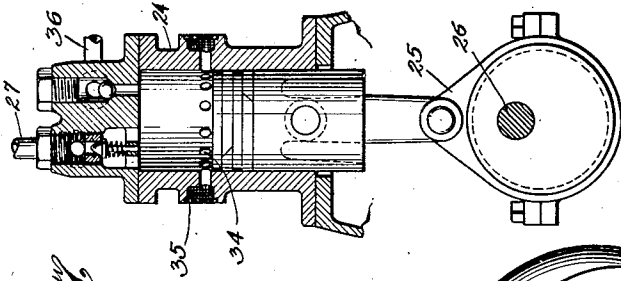


Fig. 1

Fig. 8

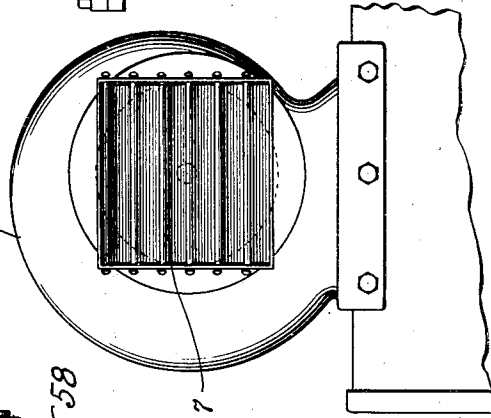
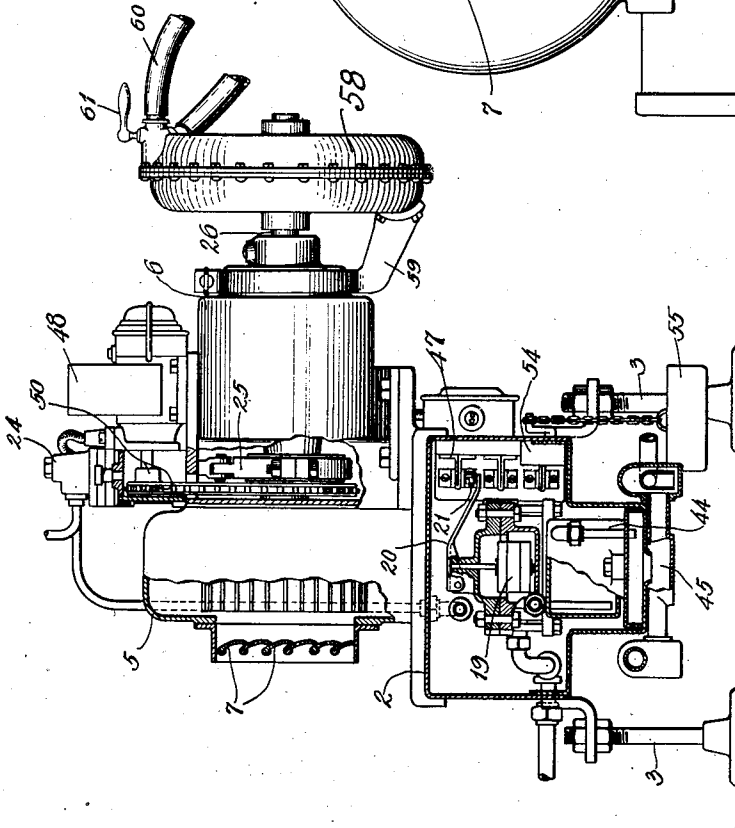


Fig. 6

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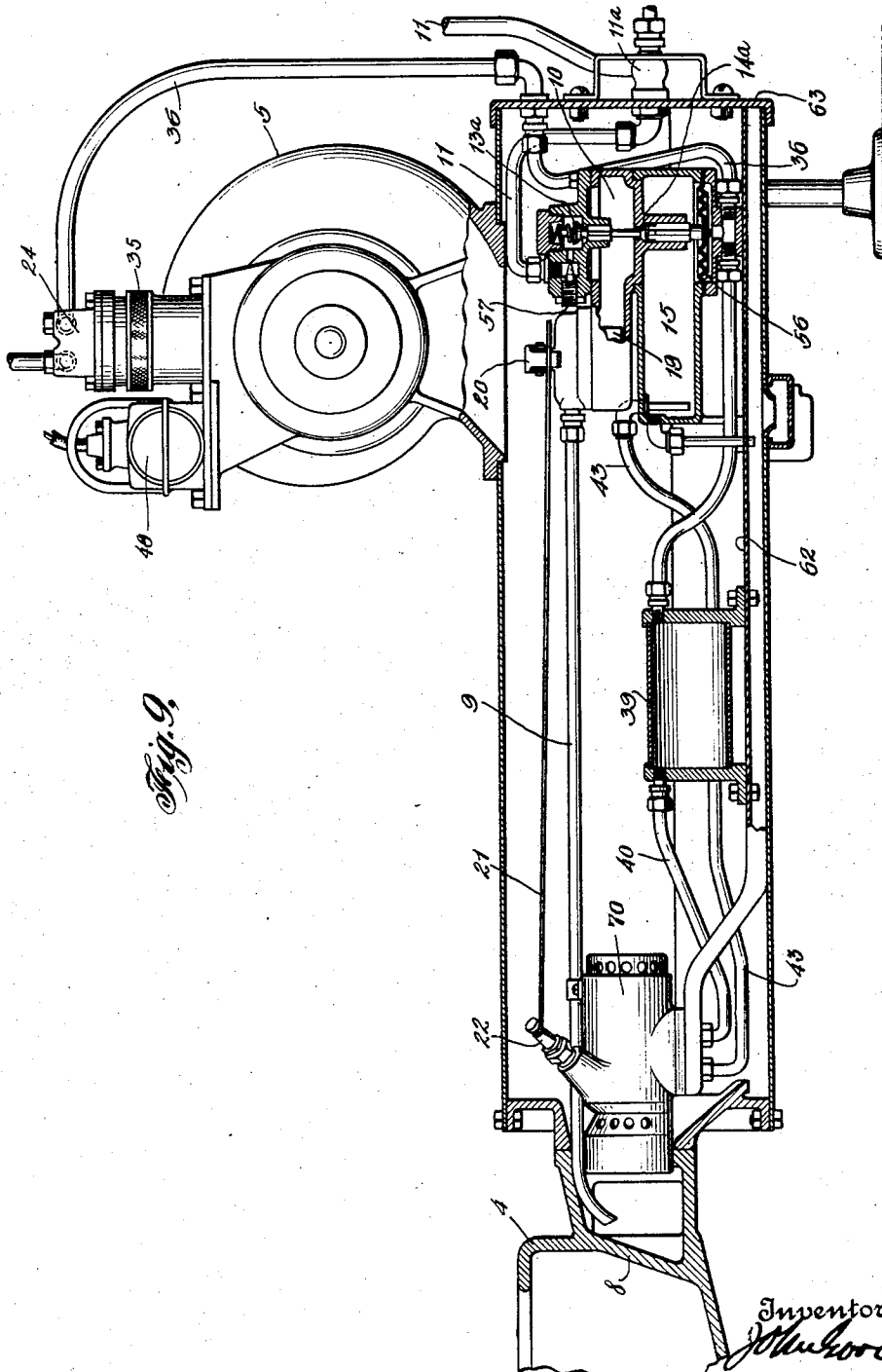


Fig. 9.

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OIL-BURNING APPARATUS.

Application filed August 6, 1924. Serial No. 730,332.

The invention relates to oil burners of the kind adapted for automatic control or for house heating purposes and consists in the general organization of parts and sub-combinations thereof, as hereinafter more fully pointed out in connection with the accompanying drawings, wherein

Fig. 1 is a side elevation of the complete apparatus in the form at present preferred, including also a diagram of the essential electric circuit.

Fig. 2 a larger scale vertical longitudinal section through the air casing and through the vacuum supply tank.

Fig. 3 a horizontal plan with parts broken away of the interior of the air casing.

Fig. 4 a vertical transverse section through the magnetic valve and control chamber.

Fig. 5, a similar section of the control chamber illustrating the ignition cut-off.

Fig. 6, a cross section of the air casing taken at the ignition cut-off and showing also parts of the electric motor magneto and air pump.

Fig. 7 a large scale sectional detail of the air pump.

Fig. 8 a side view of the suction intake of the fan blower and Fig. 9 a longitudinal section of a modified form of control chamber.

The apparatus is herein shown as applied to an existing type of house heating boiler or furnace diagrammatically indicated at 1 in Fig. 1, and of which the normal fire box will be herein referred to as the combustion chamber. The burner proper comprises a horizontal air trunk or casing 2, supported on legs 3 at its outer end and projecting into the combustion chamber at the other end where it is connected to, or terminates in, a fire pot 4. Air is supplied to this fire pot through the casing 2 from a motor-fan or blower 5, mounted on the upper side of the casing and communicating therewith through an aperture in its top wall. The electric motor 6 for the blower is also mounted on the casing.

The air entrance to the blower is provided with an automatic damper comprising, in the present case, a set of pivoted louvers 7 contained in a frame secured directly to the blower casing. These are of very light weight and are freely pivoted and open in-

wardly by the suction draft of the fan, but when the latter has stopped, they close by gravity, so that communication from atmosphere to the combustion chamber of the furnace is thereafter shut off. This automatic closure of the air path to the furnace has the effect of preventing entrance of outside cool air under the natural draft of the chimney whenever the fan is stopped and the burner inactive and thereby conserves heat by preventing the cooling effect that would thus otherwise occur.

The air supplied through the casing enters the fire pot through two openings on opposite sides of the central transverse baffle wall 8 and the oil or other liquid fuel is delivered by gravity from the fuel pipe 9 onto the floor of the pot, just behind this baffle wall, so that it may flow around the latter, over the corrugations in the bottom of the pot and toward the center of the pot, becoming vaporized in the meantime by the effect of the heat already present in the walls of the pot. The vaporized oil mixes with the air and burns in a flame arising from the pot into the combustion space of the furnace. For this normal combustion the fuel is supplied at a sufficient rate so that there is only the slight and usual excess of air.

This burner represents the type at present preferred for use in connection with the present invention, but it will presently become apparent that other types of burners in which the fuel is sprayed instead of being gravity-delivered, may also be employed without departing from the principles of the invention.

Fuel is supplied to the gravity pipe 9 through a lag chamber 10 and a pipe connection 11 from a vacuum supply tank 12, mounted in an elevated position. The fuel from the tank, through pipe 11 enters the lag chamber 10 under the control of a valve, which in Figs. 1 to 8, is electro-magnetically operated by the current in the fan motor circuit so that the valve is only open when the fan is working, that is, when current is being supplied to the fan motor. The feed pipe 9, above referred to, takes the fuel from the chamber 10 at a point near its top as indicated in Fig. 2, so that when the valve has opened, this chamber must become substantially filled before discharge of fuel by the feed pipe can take place. A predetermined

delay, or lag, in the delivery of the normal rate of fuel supply is thus obtained.

As shown more clearly in Fig. 4, the magnetically operated valve comprises two valve members, an upper member 13 seating downwardly and controlling the fuel flow from the pipe 11 into the lag chamber, and a lower valve member 14 seating upwardly and controlling a bottom outlet from the lag chamber into a lower fuel-receptacle 15, which is the immediate fuel supply for the starting burner later described. The stem of this double valve is attached to the armature 16 of an electromagnet 17 mounted above and outside of the lag chamber, being separated therefrom by an intervening non-magnetic cover 18. The coils of the magnet are in circuit with the motor 6 as indicated in Fig. 1, so that as long as the motor is in action fuel flows continuously through the upper valve and into the lag chamber. When the current is cut off, the control valve drops, which not only interrupts the fuel flow to the lag chamber, but also, and simultaneously, opens the bottom valve 14, emptying the contents of the lag chamber into the starting burner receptacle 15. The detail of the construction of the magnetic valve will be clear enough from the drawing.

The left end of the lag chamber contains a float 19, the upstanding stem of which projects to the outside of the chamber into engagement with a metallic finger 20 (see Fig. 5) pivoted on the cover cap of the lag chamber. When the apparatus is set in action after a period of rest, and while the lag chamber is filling with liquid fuel, entering by way of the control valve 13, this float rises and gradually raises the hinged finger 20 until it encounters and thereby grounds the ignition wire 21, which is a bare wire conducting the igniting current to the ignition device or spark plug 22 of the starting burner, presently to be described, and thereby renders the ignition device inoperative. The float and finger are arranged to ground the ignition wire before the fuel has begun to discharge through the feed pipe 9, that is to say, during the lag period, so that no electric ignition of fuel or vapor in the fire pot can occur after the normal fuel feed has begun or while it continues. This ignition cut-off affords a safeguard against accidental explosion, as later explained and at the same time, in the case of a magneto-operated ignition system, prevents the continued emanation of electric oscillations therefrom which would affect any radio reception apparatus located in the building, magneto currents being of audible frequency.

Oil is supplied to the elevated vacuum tank 12 by the air suction effect of a small air pump 24, shown in larger scale in Fig. 7,

and mounted on the casing of the motor or blower. The design of this pump is clear in the drawing; its plunger is operated by an eccentric strap 25 on the motor armature shaft 26 between the armature proper and the rotor of the fan as indicated in Fig. 6. The pump suction effect is transmitted by sucker pipe 27 to the upper part of the vacuum tank 12 and through the latter to the primary supply pipe 28, connected with the main oil tank 29, which is generally located outside the building, buried in the ground and usually at a level considerably lower than the vacuum feed tank. The oil pulled up through this main supply pipe passes a non-return check valve 30, situated near the junction with the vacuum tank and which exercises an important function on the automatic operation of the apparatus. When the inflowing fuel has filled the tank to a predetermined level, the float 31 therein is raised sufficiently to open the vent 32, which breaks the vacuum and thereby takes the load off of the pump. Thereafter the air pump merely sucks air in through the vent 32 with no appreciable resistance.

The importance of the non-return check 30 is incident to the control of the apparatus by thermostat (33) which is, or should be, capable of starting and stopping the electric motor on a reasonably narrow margin of temperature variation. When the thermostat calls the burner into action, thereby causing the operation of the fan motor and the air pump, the suction effect coincidentally established in the vacuum tank becomes effective to cause the immediate delivery of oil from the supply pipe 28, because such pipe has been held full of fuel by the action of the non-return check valve 30, whereas otherwise, if the check valve were not present, some little time would necessarily elapse while the oil could be drawn to the vacuum tank from a possibly remote main tank 29. In the event of a series of intermittent burner operations of short duration such as might be the result of close margin operation of the thermostat, the vacuum tank might become exhausted of fuel because of the delay in arrival of the fuel from the main tank and consequent insufficient delivery, but by the aid of the check valve, fuel begins to enter at once on each starting and thus delivers fuel exactly according to the suction demand, and this possibility of burner failure is accordingly eliminated.

The air pump 24 is provided with a ring of inlet ports 34 protected by a screen 35 and overrun by the pump plunger at the end of its suction stroke. These holes admit atmospheric air to the pump chamber, which air together with any air drawn through the vacuum tank, is compressed and discharged through the pressure air pipe 36, to fitting 37 on the end wall of the air trunk

and thence by way of pipe 38 to an air dome or chamber 39 and thence by pipe 40 to an atomizer air-jet nozzle 41 in the starting burner.

5 The starting burner comprises a cylindrical shell 70 set in rear of the fire pot baffle 8 and between the two air entrances to the fire pot above referred to. It is provided with the spark plug 22, above referred to, and also with a number of air entrance holes as indicated in Fig. 2, some of which are in front of the air jet 41 and some of which are in rear of it and both of which receive blower air from the casing 2 in which this burner is located. The air jet aspirates oil from the nozzle 42, which is connected by oil pipe 43 with the receptacle 15, above referred to. This receptacle contains only so much oil as has been admitted to it by the release of the magnetic valve above described, and the level therein is prevented from rising in any event above that of the fuel nozzle 42, by the overflow pipe 44. It thus contains only a limited quantity of fuel and accordingly provides only a limited period of combustion operation for the starting burner. The air pump, being geared to the motor shaft, is continuously operated and continuously delivers air under pressure to the atomizing nozzle, the effect, therefore, being to produce an atomized fuel spray in the starting burner only as long as the supply of liquid lasts in the chamber 15, which is somewhat longer than the lag period above referred to. The overflow pipe 44 empties into a drainage sump 45 described below.

The purpose of the spark plug 22 is to ignite the finely atomized spray of fuel produced in the manner described. The ignition wire 21, above referred to, contains a spring to keep it taut for engagement by the grounding finger 20 and is stretched between the plug and a contact clip 46 mounted on the end wall of the air trunk. This clip is engaged to a second clip and a wire 48, shown in Fig. 1, connects the latter contact clip to a magneto 49, which is also mounted on the motor blower casing and continuously driven from the armature shaft by means of a sprocket chain 50 (see Figs. 2 and 6). But, by reason of the action of the grounding finger above described, the ignition current operates the spark plug only during the limited period required for the fuel entering the control chamber 10, to fill the latter to a predetermined extent, less than enough to start the main fuel feed by the pipe 9.

The electric control of the apparatus above described may be designed as customary in burners of this class. That is to say, the thermostat 33 above referred to controls a transformer-relay 51 of known construction, which is connected to the house service lines 52 in the building as the source of current. A falling temperature affecting the thermo-

stat 33 has the effect of closing the motor circuit 53 so as simultaneously to operate the electric control valve and the fan motor; a rising temperature opens the motor circuit, as will be understood. This circuit also includes an emergency switch 54 (see Fig. 1) adapted to be operated and to open the circuit by the increasing weight of a bucket 55 supported by chains from the crank handle of the switch. The bucket is arranged to receive any liquid fuel which may happen to enter the fuel sump 45, having drained into the same from the air casing or fire pot. In the event of failure of ignition or other cause, liquid fuel accumulating in the bucket 55 will overweight the crank arm, operate the switch 54 and stop the motor. This emergency device is well-known in the art and forms no part of the present invention.

Referring now to the modified form of Figure 9, all of the parts there shown will be recognized to be the same as previously described, excepting the control mechanism which, in this case, is operated by air pressure instead of electrically. This control mechanism comprises, as before, an upper control chamber 10 including a grounding finger float 19 and a lower starting burner oil receptacle 15. Fuel from pipe 11 enters the control chamber under the control of a valve head 13^a corresponding to the valve 13 in the form first described. This valve head is connected by its stem to another valve head 14^a, corresponding to valve 14 above described, and both valve heads are connected for operation by a flexible diaphragm 56 exposed on one side to the liquid fuel in the receptacle 15 and on the other side to the air pressure in the air line 36 connecting the air pump with the atomizing air nozzle in the starting burner. The mechanical design is clear enough in the drawing. The effect of its operation is the same as in the electrically operated valve, that is to say, for as long as the apparatus is in operation, the air pump also is in operation and the pressure of the air delivered thereby, being exerted on the diaphragm 56 presses the double valve upwardly holding the valve 14^a closed and the valve 13^a open. While this condition is maintained fuel from the pipe 11 may flow into and through the chamber 10, with the appropriate lag, to pipe 9 and thence to the firepot as before. Whenever the apparatus stops, that is to say whenever the circuit of the blower motor is opened the air pressure in the air line 36 ceases and thereupon the spring shown at the upper end of the double valve closes the valve 13^a and opens 14^a, thereby emptying the contents of the lag chamber into the fuel receptacle and charging the latter for the next combustion period of the starting burner. In this form the flow of fuel into the control chamber is subject to regulation by means of the needle

valve connected at 57 and may be regulated accordingly, although in both forms the oil line is supplied with a valve 11^a, which may be a shut-off valve mounted on the end wall of the air casing.

The operation of the apparatus, above described, is as follows: Assuming the thermostat to experience a temperature less than its setting, the relay 51 acts to close the motor circuit 53 starting the motor blower, air pump and magneto in operation and simultaneously, in Figs. 1 to 8, energizing the magnet coil 17 which opens the main feed valve 13 and closes valve 14; in the modified form of Fig. 9, the pressure established in the air line 36 by the air pump, acting through the diaphragm, similarly opens the feed valve 13^a and closes 14^a. It will be understood that at the close of the last previous operation of the apparatus, a quantity of oil was dumped from the lag chamber 10 into the starting burner fuel receptacle 15, by the opening of valve 14 or 14^a as the case may be and this limited quantity of oil is therefore present in receptacle 15 on the restarting of the apparatus. It may be noted here that the amount of oil so present is determined by the cubical capacity of the lag chamber below its outlet into the feed pipe 9 and that this can, of course, be designed as requirements dictate. The effect of the operation of the air blower is to start the delivery of the normal supply of combustion supporting air through the air casing and into the combustion chamber, and the effect of the opening of the feed valve 13 is to start the flow of oil from the vacuum tank into the lag chamber 10. The effect of the operation of the air pump is to suck air, or fuel, into the vacuum supply tank according to the position of the float 31 therein, and as will be understood. If the float is low, the pump sucks fuel into the tank, and by virtue of the presence of the check valve in the oil line, such flow begins immediately on the beginning of the suction, notwithstanding the remoteness of the main tank 29. If the float is high, the pump merely draws air into the tank through the atmospheric vent 32 as before described. The air delivered from the pressure side of the pump passes by way of the air line 36 into air chamber 39 and as soon as the appropriate pressure builds up in the latter chamber, is discharged as a vigorous air jet through the nozzle 41 of the starting burner. This jet aspirates fuel from the starting burner receptacle 15 through the oil nozzle 42 producing a finely atomized and spark ignitable oil spray in the starting burner. The effect of the air chamber 39, in the air jet line is to smooth out the pulsations of the pump and at the same time, to produce a slight lag in the delivery of the oil spray, which thus occurs slightly after the begin-

ning of the main air flow in the furnace. A similar effect could also be produced by using a larger air pipe without the air chamber. The spark plug becomes energized by the magneto 48 at about the same time as the beginning of the oil spray in the starting burner and ignites such spray. The resulting flame is supplied with combustion air from the air trunk entering the starting burner through the series of holes already referred to. The flame thus produced contains sufficient air to burn with cleanliness and plays on the baffle wall 8 of the fire pot heating it and the adjoining walls, and continues to burn until the available supply of fuel in the receptacle 15 is exhausted, at which time the starting burner goes out of action, although the air jet 41 continues blowing over the spark plug terminals which thereafter keeps them and the oil nozzle 42 immune from the effect of the high temperature.

During the combustion period of the starting burner, fuel oil has been flowing by gravity into the lag chamber 10 gradually raising the float 19, and eventually grounding and de-energizing the ignition device as above explained. This may occur more or less immediately after the starting burner begins to function. Before the starting burner goes out of action, the liquid level in the lag chamber 10 will have reached the level of its outlet to the feed pipe 9 and the oil will have begun to feed to the floor of the fire pot, immediately in front of the starting burner, i. e. into the flame of that burner, where it is quickly vaporized and ignited. The supply of fuel for the starting burner is limited so that it is completely consumed shortly after the main burner thus comes into action.

The effect of the sequence of operations above described is to establish the center of the combustion zone, at first, at or in the entrance to the fire pot, that is to say, the initial combustion occurs in the starting burner itself or directly in front of it and adjacent the baffle wall 8, and thereafter, when the starting burner goes out and the main burner comes into action, the zone of combustion, now a much larger combustion, is established at or near the center of the pot, in which position it is further removed from the starting burner, and the latter is thereby less subject to injury by the radiant heat which is very intense. This protection, produced by advancing the combustion zone away from the starting burner, supplemented by the cooling effect of the air jet and blower air, keeps the starting burner indefinitely in a good operating condition notwithstanding its close proximity to the fire pot and the described arrangement and action represent an important part of this invention, when applied to apparatus hav-

ing main burners of the surface-vaporizing or non-spraying type, as in the case illustrated.

It will, of course, be understood that the combustion in the main burner continues by the effect of the continued operation of the electric motor 6, until the temperature of the thermostat or the condition of such other control means as may be employed, has reached the selected cut-off point, whereupon the relay 51 is operated to open the motor circuit, closing the feed valve 13, stopping the main burner and dumping the contents of the lag chamber into the oil receptacle 15 of the starting burner ready for the next call when the same cycle will be repeated.

Certain elements of danger inhere in the use of automatically controlled oil burning apparatus and may arise either from the failure or delayed action of the ignition or some other part, or from maladjustment, tampering or other abnormal condition, and all of these elements of danger are satisfactorily eliminated in apparatus embodying the principles of operation above described. By way of example it may be pointed out that the possibility of explosion of any fuel vapor inside the closed combustion space is eliminated, according to the present invention, by the organization or control of the ignition device so that it comes into action only at such time as the combustion space is receiving air from outside the furnace greatly in excess of the combustion requirements of the fuel being delivered at that time, that is to say in excess of the requirements of the initial oil spray in the starting burner. Specifically, in the present case, this arrangement is produced by the lag in the supply of the main fuel by pipe 9, which allows the air from the fan to blow through the starting burner and main burner before the main fuel supply begins, thereby scavenging the combustion spaces of any explosive vapors that might accidentally be present and insuring that only the relatively small quantity of initial fuel, i. e. from the starting burner, can be ignited by the spark. This sprayed fuel does not explode or if it should, is too small to be dangerous. Thus, during the period that the starting burner is in action, and before the main fuel feed comes on, the air in the pot and combustion chamber is greatly in excess of that needed for the combustion of the sprayed fuel and is enveloped and surrounded, so to speak, by this excess of air which, although it may be partially mixed with some fuel vapor, nevertheless provides a high degree of safety from explosion. This safety effect is present even if the fire pot or other interior parts are still red-hot from an immediately previous operation. Even by starting the apparatus in action before the lag chamber

has fully dumped into the starting burner receptacle, a condition which might occur as the result of thermostatic operation, or by playing with the thermostat, it is impossible to produce an explosion because if it be started before the grounding finger has parted from the ignition wire, the ignition device is dead, or, if it be started after the ignition device has become active, the scavenging effect of the excess or large proportion of blower air affords the same protection and the spark at the plug cannot occur in an explosive mixture.

It will be apparent that these measures of safety are in part the result of the initial delivery to the burner spaces of a relatively large quantity of air and a relatively small quantity of fuel and igniting the fuel while these initial, abnormally lean proportions are maintained, and thereafter bringing on the normal or running proportions wherein the quantities of fuel and air approximate the proportion necessary for substantially complete combustive combination. This effect is automatically produced in the apparatus, above described, by delivering a constant air supply by the operation of the fan and increasing the rate of fuel supply from a very little rate for ignition purposes to the maximum rate for normal combustion, but it will be apparent that either component of the combustive combination can be controlled with the same ultimate effect and that such control and sequence can be obtained by means of a wide variety of different kinds of mechanism and further, that the safety effect is quite independent of the style of main burner used, whether it is designed with a special starting burner which delivers the initial low rate fuel feed or whether both rates of feed are produced through the same pipe or orifice, because the object in any case, as will now be understood, is to establish a relatively large proportion of air in the combustion spaces when the igniting device becomes active.

As a further precaution against failures the fuel pipe 11 is extended upwardly above the bottom of the vacuum tank 12 for a considerable distance, so that in the event of leakage of the main feed valve 13, the amount of fuel that can leak from the vacuum tank into the lag chamber and thence into the receptacle 15 is so slight in proportion to the capacity of the latter receptacle as not to overflow from it, or not to overflow from it to such an extent as would be sufficient to operate the trip bucket when it drains into it. Such leakage of the feed valve 13 and consequent overflow might occur from the result of foreign matter in the fuel oil lodging on the seat of the feed valve 13 and would result in burner failure if the effect was to trip the safety bucket, which, of course, requires re-setting by hand

before the apparatus can be again set in operation. The effect described is the result of the relation between the deliverable quantity of fuel contained in the vacuum tank and the capacity of the starting burner oil receptacle, the former being small enough, or the latter large enough to accommodate the maximum amount of oil that can flow through a leaking feed valve. This relationship also constitutes an important part of this invention independent of the other features above described, and can obviously be applied to various and different forms of the oil burning apparatus.

15 A still further precaution against the failure of the burner for house heating purposes consists in the application of two sources of motive power to the shaft 26 of the fan blower, one of these sources being the electric motor 6, above referred to, and the other being a rotary water motor, Pelton wheel or the like, marked 58 and shown in Fig. 6. This hydraulic motor is attached, removably, to the motor casing by means of a clamp bracket 59 and wing nut. In the event of failure of current from the electric service lines, an ordinary garden hose, such as indicated at 60, can be coupled to the inlet of the motor as indicated and under the control of the throttle 61 can be utilized for driving the blower by water instead of electric power. In the form of Figs. 1 to 8 the feed valve 13 must be opened or other means provided for supplying fuel to the lag chamber during its hydraulic operation and this can be done by unscrewing and lifting off the magnet and the cover plate 18. When applied to the form of Fig. 9, no such additional means is required because the feed valve in that case is mechanically operated by the air pressure generated by the air pump.

The drawings illustrate the organization of all the interior motor-driven mechanism which supplies oil and air to the combustion chamber as mounted upon a drawer slide 62 fixed to the end wall 63 which has a drawer pull handle so when the couplings of air pipe 36 and fuel pipe 11 have been disconnected, the drawer slide carrying all the interior parts can be withdrawn bodily from the air casing. The electrical connections from the relay 51 and the magneto to the motor and spark plug, respectively, are made separable, being formed by complementary engaging clips, such as 46 and 47, Fig. 3 mounted respectively on the removable drawer end wall and the fixed side wall of the casing so that when the drawer is removed, these connections are broken and when it is replaced, they are properly remade again.

I claim:—

1. Oil burning apparatus comprising means for delivering oil to a place of combustion,

means for delivering thereto a quantity of air sufficiently in excess of the combustion requirements of the oil to produce a non-explosive mixture, means automatically operative at a predetermined period thereafter to conform the mixture proportions substantially to the combustion requirements and ignition means active only while such non-explosive proportions obtain in the combustion space.

2. Oil burning apparatus comprising means for delivering oil to a place of combustion, means for delivering thereto a substantially constant supply of air sufficiently in excess of the combustion requirements of the oil to produce a non-explosive mixture, means automatically operative at a predetermined period thereafter to increase the oil supply to substantially conform the mixture proportions to the combustion requirements and ignition means active only while such non-explosive proportions obtain in the combustion space.

3. Oil burning apparatus comprising a blower for supplying air to a place of combustion two means for supplying oil thereto, one of said means being adapted to supply fuel thereto at a sufficiently low rate to produce a non-explosive mixture in the combustion space and the other of said means at a higher rate of delivery and an ignition device active only during the operation of said first mentioned means.

4. Oil burning apparatus comprising means for delivering oil to a place of combustion, means for delivering thereto a quantity of air sufficiently in excess of the combustion requirements of the oil to produce a non-explosive mixture, means automatically operative at a predetermined period thereafter to conform the mixture proportions substantially to the combustion requirements, ignition means operative while said non-explosive proportions obtain in the combustion space and means operated by said conforming means for rendering the ignition means inactive.

5. Oil burning apparatus comprising means for delivering air and oil to a place of combustion initially in non-explosive proportions and subsequently in substantial accordance with combustion requirements, a limited source of supply for said initial delivery, means for interposing a delay between the initiations of the two deliveries and ignition means active only during the first mentioned delivery.

6. Oil burning apparatus including a source of oil supply, means automatically operative upon each interruption of the normal working of the apparatus to segregate a relatively small body of oil, feeding and ignition means for the latter operative to initiate the subsequent operation of the apparatus, an oil line for continuously supply-

ing the apparatus during normal operation, means for delaying the activity of said oil line and means for rendering the ignition means inactive prior to the normal fuel delivery from the oil line.

7. Oil burning apparatus comprising means for supplying air to a place of combustion, means for initially delivering oil thereto at a low rate for ignition and subsequently at a higher rate and a lag chamber in the oil supply line adapted to interpose a time interval between said low and high feed rates.

8. Oil burning apparatus comprising in combination with a source of fuel supply and feed line connecting the same with a place of combustion, a valve in said line operative after each period of activity of the apparatus to prevent the flow of oil through said line and to segregate a relatively small body of oil, feeding and ignition means operative upon the subsequent activity of the apparatus to feed and ignite oil from said segregated body and means for operating said valve to cause the reinstatement of the oil flow through said line subsequent to the said operation of the feeding and ignition means.

9. Oil burning apparatus comprising a main oil burner, a starting burner adapted to operate at a lower feed rate for a limited period and prior to the operation of the main burner, and motor driven mechanism for supplying air and oil to both burners including automatic means for measuring the oil supply for the starting burner to limit its period of operation.

10. Oil burning apparatus comprising means for delivering oil initially at a low rate for ignition and later at a higher rate for normal combustion, a receptacle arranged for trapping oil to supply said low rate and means for automatically delaying the delivery at the higher rate until the delivery of low rate fuel for ignition from said receptacle has occurred.

11. Oil burning apparatus comprising main and starting oil burners, an air blower, a vacuum tank for supplying oil to both burners, an air pump connected for operating said tank and supplying air to said starting burner, and a motor for driving said blower and air pump.

12. Oil burning apparatus comprising main and starting oil burners, an air blower, a vacuum oil supply tank and an air pump connected for operating said tank and for spraying the oil in said starting burner.

13. Oil burning apparatus including an oil burner, a vacuum tank for supplying oil thereto, a blower for supplying low pressure combustion air, an air pump connected for operating said tank and supplying higher pressure air to the burner and a motor for driving the blower and pump.

14. Oil burning apparatus comprising means for effecting a preliminary delivery of fuel when the operation of the apparatus is initiated, a limited starting source therefor, an igniter for the fuel so delivered, a main fuel supply, means whereby the latter is rendered active subsequent to the preliminary delivery, a control means permitting or preventing the operation of said main supply in accordance with the fuel ignition or failure thereof and means for rendering the igniter inactive prior to the delivery of said main fuel.

15. Oil burning apparatus comprising means for delivering oil initially at a diminishing rate for ignition and later at full rate throughout each normal combustion period, an ignition device, a receptacle arranged for trapping oil to supply said first mentioned rate, means for automatically delaying the delivery at the full rate until after delivery from said receptacle has occurred and means for rendering the igniter inactive prior to the delivery of said main fuel.

16. Oil burning apparatus including a source of oil supply, means automatically operative upon each interruption of the normal working of the apparatus to segregate a relatively small body of oil, feeding and ignition means for the latter operative to initiate the operation of the apparatus, air delivery means operative coincidently with said feeding and ignition means to deliver sufficient air to the combustion space to render the mixture therein nonexplosive, an oil line for continuously supplying the apparatus during normal operation and means for rendering said line active subsequent to the operation of said feeding and ignition means.

17. Oil burning apparatus comprising means for supplying air to a place of combustion and means for initially delivering oil thereto at a low rate for ignition and subsequently at a higher rate, said means including two oil supply lines and a lag chamber for delaying the delivery through one of said lines the outlet side of said line with respect to the chamber being connected to the latter adjacent the upper part thereof.

18. Oil burning apparatus as claimed in claim 17 including an ignition device for said initial oil delivery and means for rendering the device inactive in response to predetermined accumulation of oil in said chamber.

19. Oil burning apparatus comprising a source of oil, means for delivering oil therefrom to a place of combustion for normal burner operation, means for effecting an initial lower rate oil delivery for ignition purposes, a supply chamber for the latter independent of said normal supply and adapted to be emptied as a result of each burner starting, and valve means operative only

upon the cessation of normal burner activity to replenish said supply chamber.

20. Oil burning apparatus including an oil line for an initial starting delivery, a supply chamber constituting a limited source of oil for said initial delivery, a main oil line for effecting delivery throughout the normal combustion period, a lag chamber in said main oil line for delaying the activity thereof until after said delivery from said limited source and means operative upon the cessation of each period of burner activity to transfer the contents of the lag chamber to the supply chamber, whereby the latter is replenished for the next subsequent starting of the apparatus.

21. Oil burning apparatus comprising means for delivering oil to a place of combustion, means for delivering thereto a quantity of air sufficiently in excess of the combustion requirements of the oil to produce

a non-explosive mixture, means automatically operative thereafter to conform the mixture proportions substantially to the combustion requirements, an igniter and means for rendering the igniter inactive prior to the operation of said conforming means.

22. Oil burning apparatus comprising means for delivering oil to a place of combustion, means for delivering thereto a substantially constant supply of air sufficiently in excess of the combustion requirements of the oil to produce a nonexplosive mixture, means automatically operative thereafter to increase the oil supply to substantially conform the mixture proportions to the combustion requirements, an igniter and means for rendering the igniter inactive prior to the operation of said increased oil supply means.

In testimony whereof I have signed this specification.

JOHN GOOD.